Source Apportionment of Air Pollutants Emitted in Maine in 2002

Bureau of Air Quality Control
Maine Department of Environmental Protection

Revised January 11, 2005

How does Maine DEP determine emission sources for air pollutants in Maine?

MEDEP and EPA have standard protocols to estimate the amount of pollutants that are released to the air. Estimations are usually made by multiplying "activity data", such as gallons of fuel burned, times an "emission factor", such as pounds of pollutant released per gallon of fuel burned. By convention, air emission inventories are often broken down into four major categories: point sources, area sources, mobile sources, and background sources.

"Point Sources" is a category comprised of stationary facilities that emit pollutants above a certain threshold, from a stack, vent or similar discrete point of release. The threshold varies between inventories, but federal rules usually establish the threshold at 10 tons per year of a single Hazardous Air Pollutant, or 25 tons of a mixture of HAPs. Estimates of point source releases are derived from summing the releases from each facility that reports. Each facility may either estimate its pollutant release from direct measurement, or based on standard estimation techniques for the relevant process at the facility.

"Area sources" are sources of air pollutants that are diffused over a wide geographical area. Area sources include emissions from smokestacks, vents or other point sources, that in and of themselves are insignificant, but in aggregate may comprise significant emissions. An example would be emissions from small dry cleaners or home heating boilers. Area sources also comprise emissions that do not come from a specific point source, such as Hazardous Air Pollutants volatizing from house painting, chainsaws or lawnmowers. Estimations of pollutant losses for many subcategories are made using standard techniques, often based on losses per capita or per employee.

"Mobile sources" are sources of air pollution from internal combustion engines used to propel cars, trucks, trains, buses, airplanes, ATV's, snowmobiles, etc. Mobile source inventories are often further broken down into on-road vehicles, and off-road vehicles. EPA has published models that are used to estimate releases of pollutants from these categories.

"Background" means the concentrations of Air Toxics that are from natural sources (also called "Biogenic Sources") and man-made pollutants that are either still in the air from previous years emissions, or have been emitted outside the inventory area and then transported into the region. MEDEP depends on EPA to run models that determine releases from the natural sources. Likewise, an assessment of a chemical's properties and complex air models are used to determine contributions from out-side the state, or from previous emission years.

What are Criteria Pollutants?

Under federal regulations, USEPA has developed ambient air quality standards for just six pollutants. These six pollutants are known as "criteria pollutants". The criteria pollutants are: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Particulate Matter (PM), Sulfur Dioxide (SO_2), and Lead (Pb). Precursors to these pollutants are often included with the criteria pollutant inventories.

What is the most recent full inventory for Criteria Pollutants?

Full emission inventories, covering all of the major source categories, are compiled every three years. The first full inventory was for 1990, and 2002 is the most recent inventory year. MEDEP and USEPA are still in the process of finalizing calculations and quality assurance checks of the 2002 inventory. The final figures will be published as part of the National Emissions Inventory for 2002 (NEI 2002) at the end of calendar year 2005.

However, the Mid-Atlantic/Northeast Visibility Union (MANE-VU) is conducting air transport modeling as part of the Ozone Transport Commission's (OTC) work to develop a regional approach to resolve ozone and haze exceedances along the eastern seaboard. Maine DEP, USEPA, and MANE-VU have worked together to develop a full 2002 emissions inventory of criteria pollutants (2002 MANE-VU inventory). The inventory will be used in modeling, which will simulate the atmospheric chemistry involved in the formation of ozone and fine particulate matter from the emissions of thousands of sources in the northeastern United States (and, possibly, Canada).

In order to complete the modeling work in a timely manner, MANE-Vu needed a completed emissions inventory by September of 2004. To increase the accuracy of the emissions inventory, MANE-VU launched a project to develop emission calculation guidance for states to use in those cases where EPA guidance did not exist. The intent was to ensure emission inventory consistency throughout the Ozone Transport Region, increase the accuracy of the June 2004 preliminary inventory submittal from States to EPA, and develop consistent model input formats for the MANE-VU photochemical modeling team.

Personnel turnover in the inventory program at MEDEP prevented the Department from running the mobile source models to generate emission estimates. However, MANE-VU's contractor, Pechan, ran the mobile and non-road model to derive Maine's mobile emissions.

MANE-VU, MEDEP, and USEPA have worked cooperatively to speed-up the quality control checks of this 2002 inventory data. While MEDEP believes that the emissions data is of sufficient quality to determine source category apportionment, quality control checks will continue, and a final inventory will not be published until the end of 2005. It is likely that emission estimates will change, but it is unlikely that these changes will significantly alter the major source category apportionment in this report. The data in this report includes revised emissions from the Georgia Pacific, emissions from planes, trains and marine vessels, and corrections to the open-burning emissions. It does not reflect any other changes that were made to the inventory after November 15, 2004.

More information about MANE-VU and this modeling project are available on the MANE-VU website at http://www.manevu.org/.

What are the Sources of Coarse Particulate Matter (PM_{10}) in Maine?

Particulate Matter (PM) is the term used for a mixture of solid and liquid particles in the air. PM_{10}, also known as coarse PM, refers to the fraction of PM with an aerodynamic diameter smaller than 10 microns. PM_{10} causes respiratory disease. Figure 1 shows the emission sources in Maine for coarse particulate matter from 2002, according to the 2002 MANE-VU inventory, as described above.

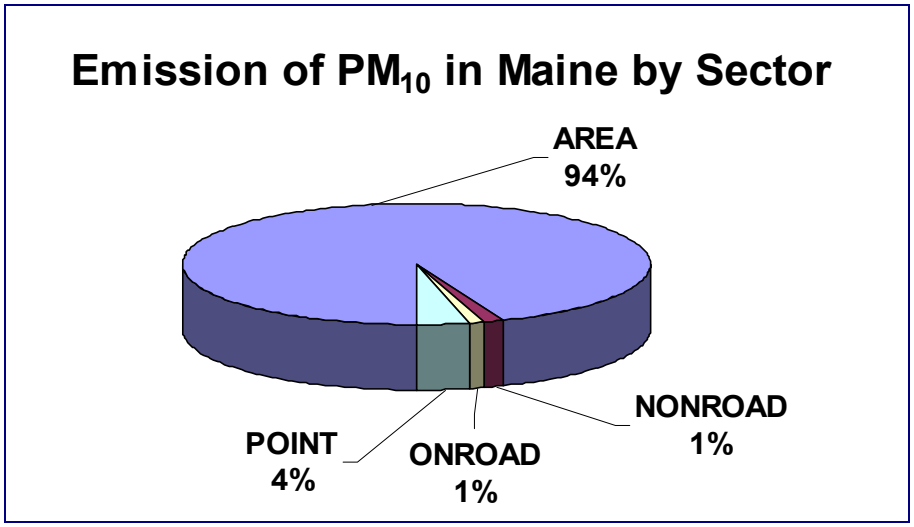

Figure 1: Source of PM_{10} per sector in 2002

What are the Sources of Fine Particulate Matter ($PM_{2..5}$) in Maine?

Fine particulate matter is PM that has an aerodynamic diameter of less than 2.5 microns ($PM_{2.5}$). This size of PM is of particular concern because it can penetrate further into the lungs, and even pass into the bloodstream of people breathing air containing $PM_{2.5}$. $PM_{2.5}$ causes respiratory and cardiovascular disease. Figure 2 shows the emission sources in Maine for fine particulate matter from 2002, according to the 2002 MANE-VU inventory, as described above.

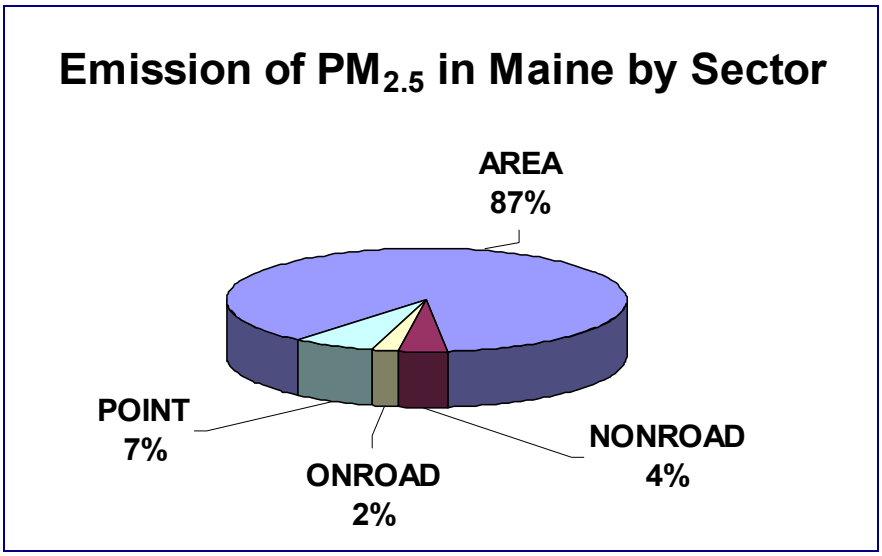

Figure 2: Source of $PM_{2.5}$ per sector in 2002

What are the Sources of Carbon Monoxide (CO) in Maine?

Carbon Monoxide is a colorless, odorless gas that is formed from incomplete combustion. It impairs the bloods ability to deliver oxygen to the body. Figure 3 shows the emission sources in Maine for CO from 2002, according to the 2002 MANE-VU inventory, as described above.

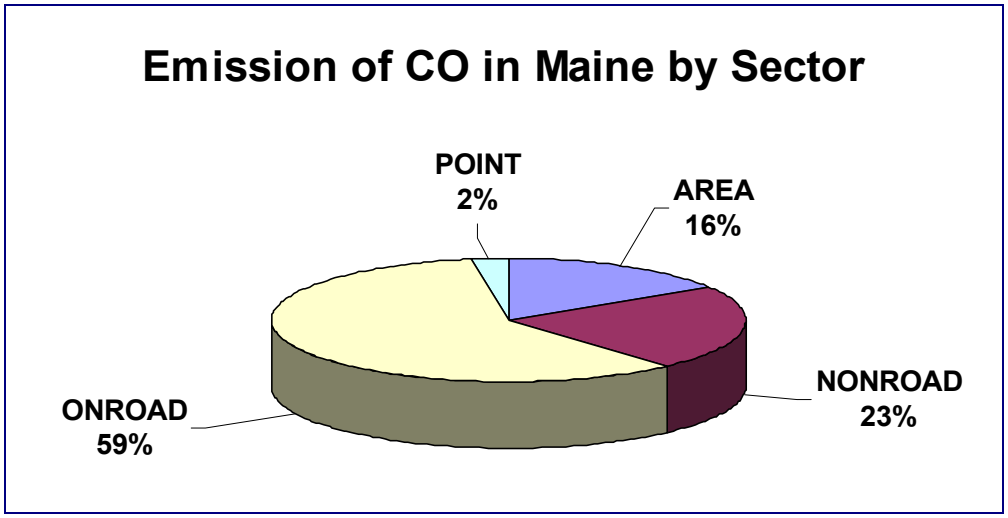

Figure 3: Source of CO per sector in 2002

What are the Sources of Sulfur Dioxide (SO_2) in Maine?

Sulfur oxides, including Sulfur Dioxide, are odorous gases that form from the combustion of fuels containing sulfur. SO_2 causes cardiovascular disease. Figure 4 shows the emission sources in Maine for SO_2 from 2002, according to the 2002 MANE-VU inventory, as described above.

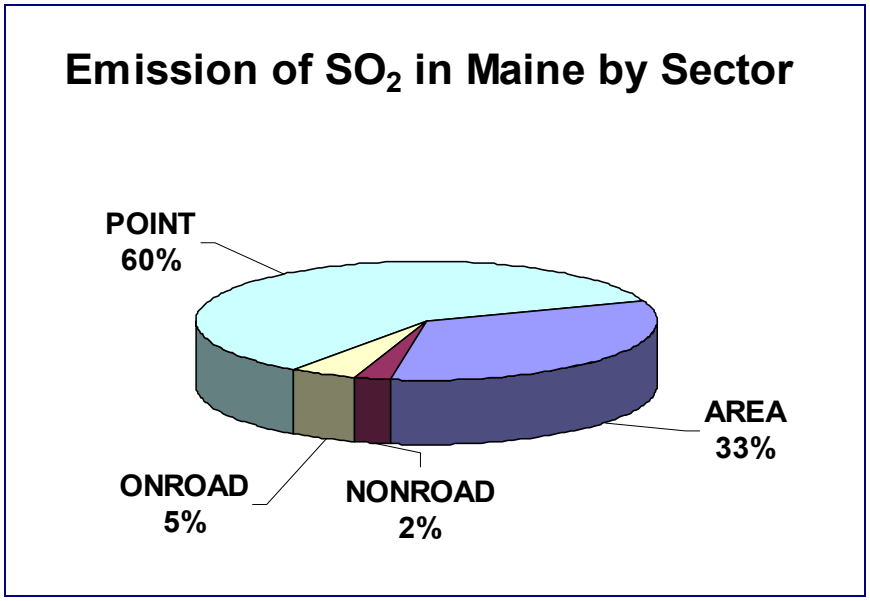

Figure 4: Source of SO_2 per sector in 2002

What are the Sources of Nitric Oxides (NOx) in Maine?

Nitrogen Dioxide, is a highly reactive, reddish brown gas that is formed through the oxidation of nitric oxide. NO_2 causes lung damage. Figure 5 shows the emission sources in Maine for NO_x from 2002, according to the 2002 MANE-VU inventory, as described above.

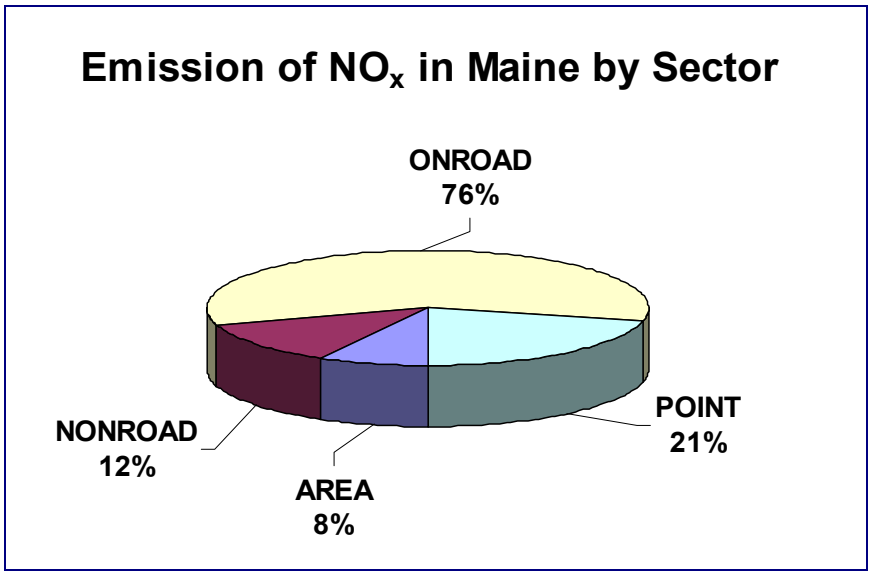

Figure 5: Source of NO_x per sector in 2002

What are the Sources of photoreactive Volatile Organic Compounds (VOCs)?

Ozone is not directly emitted to the air, but forms from other compounds under high heat and sunlight. Certain Volatile Organic Compounds (VOC) that are photoreactive are precursors to Ozone. Ozone causes respiratory illness.

Figure 6 shows the emission sources in Maine for VOC from 2002, according to the 2002 MANE-VU inventory, as described above.

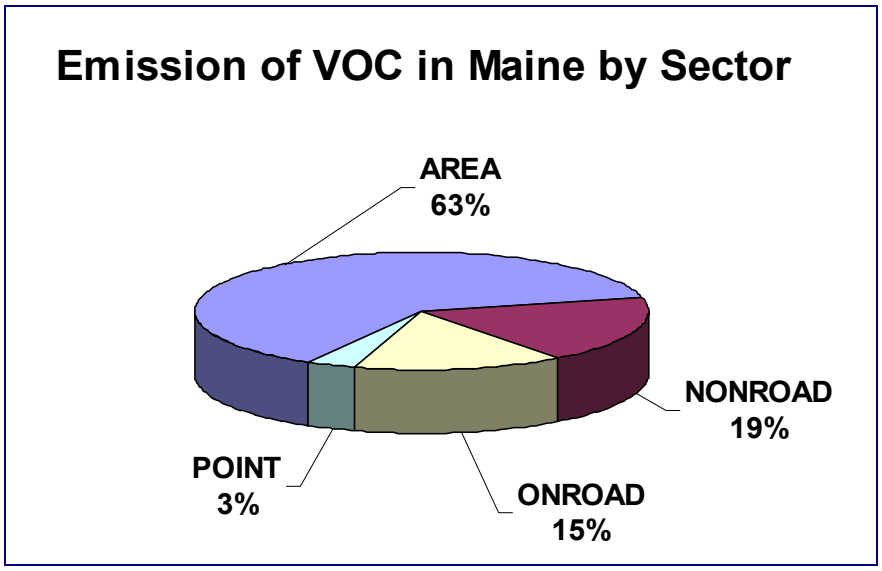

Figure 6: Source of VOC per sector in 2002

What are the Sources of all Criteria Pollutants and their precursors in Maine?

Figure 7 shows the source of the sum of CO, NO_X, $PM_{2.5}$, PM_{10}, SO_2, and VOC in Maine. Table 1 shows the tons of criteria pollutants released in Maine. This data is from the 2002 MANE-VU inventory, as described above.

Pollutant	AREA	NONROAD	ONROAD	POINT	Total
PM10	109,366	1,601	1,239	4,339	116,546
SO2	13,150	1,091	1,804	23,711	39,756
NOX	7,439	11,461	54,687	19,965	93,552
CO	109,210	156,089	410,958	17,015	693,272
VOC	96,085	28,358	23,037	5,325	152,806
PM25	34,061	1,453	934	2,567	39,016
Total	**369,312**	**200,053**	**492,659**	**72,923**	**1,134,947**

Table 1: Tons of Criteria Air Pollutants (excluding NH_3) released in Maine in 2002

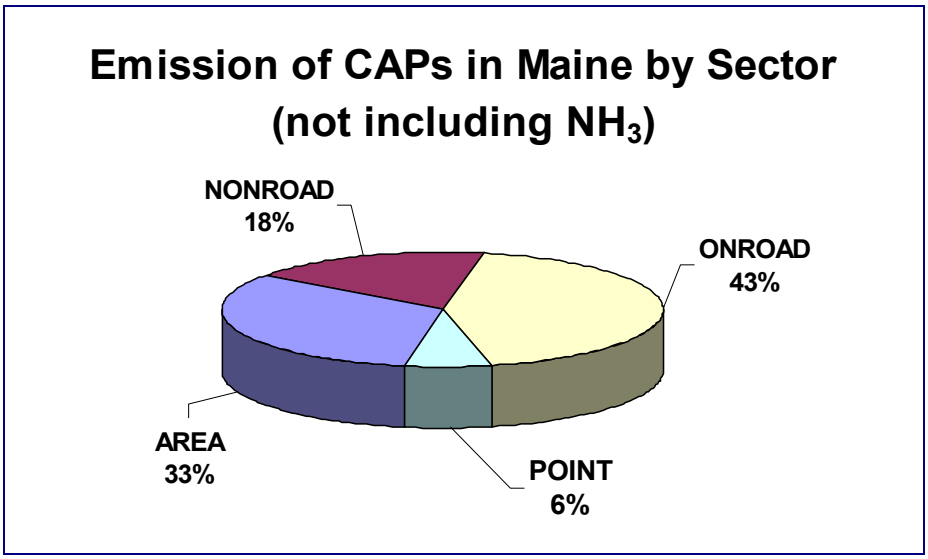

Figure 7: Source of Criteria Air Pollutants and VOCs in 2002

What are Hazardous Air Pollutants (HAPs)?

The term "Hazardous Air Pollutant" or HAP means one of 188 compounds regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP). The HAPs are listed under the Clean Air Act, Section 112 (b) and 65 FR47348. Additionally, Maine collects emissions data from point sources for 38 pollutants, which are listed in Appendix A of Maine DEP regulations Chapter 137, "Emissions Statements"[1]. Together the 188 federal HAPs and the additional 38 pollutants make up the Maine Hazardous Air Toxics (MEHAPs). MEHAPs can have a variety of health impacts, depending on the specific compound.

What is the most recent full inventory for MEHAPs?

Similar to CAP Inventories, full emission inventories for HAPs that cover all of the major source categories, are compiled every three years. The most recent full inventory year for MEHAPs is 2002, while the most recent completed inventory is the 1999 National Emissions Inventory. MEDEP and USEPA are still in the process of finalizing calculations and quality assurance checks of the 2002 inventory. The final figures will be published as part of the National Emissions Inventory for 2002 (NEI 2002) at the end of calendar year 2005.

However, Maine's Air Toxics Advisory Committee is in the process of updating the 1999 NEI with 2002 emissions data, to produce the so-called "MATI 2002 Inventory". While this process is not complete, the emissions data from this preliminary database is more accurate of current conditions than the 1999 NEI. Therefore, the source apportionment shown in is taken from the MATI 2002 Inventory. It should be noted that this inventory is still undergoing quality assurance and quality control reviews, and will likely change. MEDEP's best guess is that the source apportionments in Figure 8 could change up to 5% points, based on this QA/QC review. The data for Figure 8 does not reflect changes made to the inventory after June 1, 2004.

[1] A copy of 06-096 CMR 137 is available from the Maine Secretary of States Web Page at: http://www.state.me.us/sos/cec/rcn/apa/06/chaps06.htm.

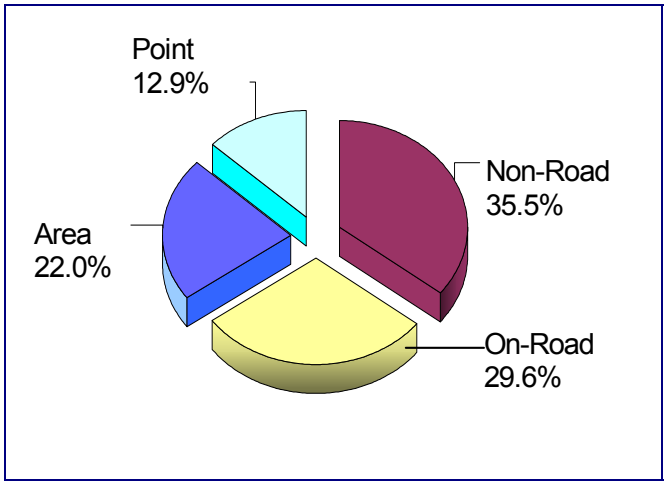

Figure 8: Source of Maine Hazardous Air Pollutants in 2002

How Do I get more information about the data in this report?

For More Information on the data contained in this report, Contact David W. Wright, Tammy Gould, or Rich Greves of MEDEP's Bureau of Air Quality Control at 207-287-2437.